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Preserving the Green Sale Value of Dying Ponderosa Pine With Lindane

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Pines with dead or dying crowns but without insects or stain in the lower trunk were sprayed in early spring with 1 percent lindane emulsion. The pheromone triplet of the western pine beetle was used to attract the beetle to some of the treated and untreated trees. By late fall 93 percent of the sprayed trees but only 7 percent of the unsprayed trees were still without insect attack or wood stain.

Retrieval Terms: salvage cuttings, *Pinus ponderosa, Pinus lambertiana,* insect damage, *Dendroctonus brevicomis,* lindane.

Efforts to salvage damaged timber are frequently hampered by the necessity to work quickly, before further damage is done by insects and stain diseases. The stumpage value of "green" timber — that is, timber without visible insect and stain damage — is much greater than that of degraded timber. The suggestion has been made that under some circumstances the green condition might be prolonged with a protective insecticide. If so, value would be saved, salvage could be conducted in a more orderly and efficient manner, and possibly some degree of insect control might be obtained.

An opportunity to test this suggestion presented itself in 1978. In late summer and fall 1977, unusual and widespread tree mortality occurred over much of the west slope of the Sierra Nevada below the fir zone. In most of the affected trees, primarily ponderosa pine (*Pinus ponderosa* Laws) and sugar pine (*P. lambertiana* Dougl.), all or much of the crown was dead, but the lower portion of the trunk was apparently still living and without attack by insects or disease. The underlying cause of this condition, which I have termed "green trunk," was apparently the 2-year drought of 1976-77. A rapid buildup of *Ips* during spring and summer 1977 was the principal overt manifestation, although both western pine beetle (*Dendroctonus brevicomis* Lec.) and mountain pine beetle (*D. ponderosae* Hopk.) were present.

Normally under such conditions we would expect western pine beetle in the lower trunks of most of the ponderosa pine. But apparently these trees were so abundant that the western pine beetle population had not developed fast enough to occupy more than a part of them. It became obvious, however, during winter and early spring 1978, that there was considerably more western pine beetle in these trees than had been suspected. In many trees, western pine beetle could be found in the lower crown portion, but not in the basal 20 to 30 ft (7 to 10 m). It was estimated that 70 to 90 percent of the trees with crowns fully or partially dead could be classed as green trunks.

Though strong efforts were made in winter 1977-78 to salvage the trees, it was obvious that many if not most would not be removed from the forest before late summer, by which time bark beetles, wood borers, and wood-staining diseases would probably have attacked them. The stumpage value of green timber was three to five times that of degraded timber: in many areas, green stumpage was

$100 to $200 per thousand board feet, whereas degraded timber was $30 to $50.

An area of affected trees was set aside to test the possibility of preserving the value of the green trunks. From previous work[1,2] I judged lindane,[3] as a 1.0 percent aqueous emulsion, to be the best candidate for such a study. The objective was to spray the test trees early in spring 1978 before any beetle activity had begun, to see whether borers and stains could be kept out, and if so, for how long the green value could be preserved. Results suggest that lindane can protect the trees for at least a full growing season.

METHODS

A 1-to 2-acre (0.4 to 0.8 ha) area of near-pure ponderosa pine was selected on the Eldorado National Forest at about 4000 ft (1220 m) elevation. It included a group of about 35 trees with half or more of the crown dead; 30 of these had green trunks while the remaining 5 had western pine beetle brood in the base. On these 30 trees, d.b.h. and percent of dead crown were measured. As most trees showed unsuccessful attacks at the base by the red turpentine beetle (*D. valens* Lec.), note was also taken of the amount of such evidence in each tree. The trees were then divided into two approximately comparable groups of 15, each group having an average d.b.h of 23 inches (58 cm), with a range of 14 to 34 inches (35 to 85 cm). One group was assigned to treatment, the other to untreated control.

Spray Treatment

On April 5 the treatment group of trees was sprayed with a 1 percent aqueous emulsion of lindane, made from a 20 percent emulsifiable concentrate, at the rate of 1 gal per 40 ft² (ca 1*l* / m²) of bark surface. The spray was applied from the ground with a standard 3-gal (11.4 *l*) tank pressure garden sprayer to the basal 20 ft (6.1 m) of the trees; this portion of the tree was the only part considered in the study. The bark was dry at the time of application. The weather was fair and calm, with air temperatures ranging from 40° to 55°F (ca 5°C to 12°C). Under these conditions, it took several hours for the bark to dry; the bark crevices took much longer to dry than the plates. All trees were dry by the next day, when a wet snow fell.

Beetle Attractant Treatment and Monitoring

To attract western pine beetles to the treated and untreated trees, containers of the triplet pheromone—exo-brevicomin, frontalin, and myrcene—were attached to treated and untreated trees, and traps were set up at the base of the trees to catch dying insects falling from the tree. These procedures were carried out at two post-spray periods. On April 11 a container was attached to each of three randomly selected trees in both the treated and untreated groups. A 1-ft-square catchment cloth trap was set up at each of these trees, and monitored for western pine beetle, its two common predators *Enoclerus* sp. and *Temnochila* sp., and other insects, at 1- to 2-week intervals until June 20. Then the pheromone and catchment cloths were moved to another set of trees—three treated and three untreated—and the monitoring procedure was repeated on these trees until the end of the test on October 24. The remaining nine treated and nine untreated trees were left undisturbed to record the natural course of events of the test period.

At the end of the study, 6½ months after application of the lindane, all trees were inspected for presence or absence of beetle activity and stain in the sprayed portion. Any prespray activity by red turpentine beetle was discounted. On December 15, trees were again briefly inspected.

RESULTS

The summary of the findings at the October inspection (*table 1*) shows that 93 percent of the treated trees were free of insect and stain activity in the sprayed portion, compared with only 7 percent of the untreated trees. The one treated tree which showed insect and stain evidence had had the pheromone container attached during the June-to-October period. There was little difference in final condition between trees with or without the pheromone in either the treated or untreated group. All degraded trees showed western pine beetle attacks along with an assortment of borers and stains.

Table 1—*Condition of ponderosa pine trees 6½ months after application of 1.0 percent lindane aqueous emulsion to the lower trunks*

Treatment	Trees	Trees green	Trees degraded[1]
1.0 percent lindane			
With pheromone[2]	6	5	1
Without pheromone	9	9	0
Untreated			
With pheromone[2]	6	0	6
Without pheromone	9	1	8

[1]Beetles, borers, and stain present.

[2]Pheromone treatment consisted of attachment of containers of western pine beetle attractant.

The December inspection of the basal log of each tree showed that of the 14 treated trees which were green 6½ months after treatment, 13 could still be so classified after 8 months. The phloem of the one remaining tree was turning reddish brown, but there was no insect attack.

The summary of insect catch (*table 2*) shows that thousands of beetles arrived at all six treated trees to which the pheromone was attached, and that the numbers of predators and other insects was comparatively low.

DISCUSSION

Prolonging the green condition of dying trees could be helpful in making salvage programs more orderly and efficient. The results of the test strongly suggest that the green value of trees such as those tested can be preserved with lindane for 6 to 7 months. Because some deterioration of the phloem had begun in one tree after 8 months, however, a full growing season may be the limit of such protection.

The cost of a control program is quite variable, depending on size, location, and abundance of the trees to be treated. Large trees in large groups near roads would be much cheaper to treat than scattered small trees far from roads. For a general example, however, if we assume a tree of 32 inches (80 cm) d.b.h. to have 1000 bd. ft. in the basal 32 ft (9.8 m), and that the stumpage price differential is $100/mbf, the cost of this saving would be about $8 to $11 ($5 for chemicals and $3 to $6 for labor). The saving here assumes that the basal 32 ft (9.8 m) are sprayed (using suitable equipment), rather than the 20 ft (6.1 m) sprayed for test purposes.

The large number of western pine beetles killed at the treated trees to which pheromone was attached suggests that such trees could be used as a direct method of reducing the beetle population in an area. This test did not include insect trapping and monitoring at treated trees without pheromone; it is likely, however, that appreciable numbers of beetles did try to attack them.

Table 2—*Numbers of western pine beetles and associates trapped at lindane-treated and untreated trees baited with pheromone*

Tree group and treatment period	Trees in group	Insects trapped[1]			
		WPB	Tem.	Eno.	Other
Treated					
April-June	3	2223	8	22	112
July-October	3	1822	0	5	27
Untreated					
April-June	3	49	0	0	2
July-October	3	24	0	0	6

[1]WPB = western pine beetle; Tem.= *Temnochila* sp.; Eno.= *Enoclerus* sp. A basal catchment cloth 1 ft square was used; to convert data to an estimate for the whole tree, multiply by 15.

NOTES

[1]Smith, Richard H. 1976. *Effectiveness of lindane against bark beetles and wood borers. In* Lindane in forestry . . . a continuing controversy. USDA Forest Serv. Gen. Tech. Rep. PSW-14, p. 11-15. T. W. Koerber, compiler, Pacific Southwest Forest and Range Exp. Stn., Berkeley, Calif.

[2]Smith, R. H., G. C. Trostle, and W. F. McCambridge. 1977. *Protective spray tests on three species of bark beetle in the Western United States*. J. Econ. Entomol. 70(1):119-125.

[3]Trade names and commercial products or enterprises are mentioned solely for information. No endorsement by the U.S. Department of Agriculture is implied.

This publication reports research involving pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

Lindane is currently under review by the Environmental Protection Agency; thus there is some question about its future availability.

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